THE ROYAL INSTITUTION.

The celebration of the Centenary of the Royal Institution, London, which took place last week, is an event of interest and importance to scientific men, emphasized to us, perhaps, by the fact that the founder of the Institution was an American. It is a somewhat curious fact that the Smithsonian Institution should have been founded by an Englishman and the Royal Institution by an American. There has not been time for an account of the exercises in connection with the celebration to reach us, but according to the program they were to include a lecture by Lord Rayleigh on the physical work of the Institution during its hundred years' existence and a lecture by Professor Dewar on its chemical work. The attendance of a large number of foreign delegates had been assured. In the meanwhile we take from the London *Times* the following facts regarding the history and scope of the Institution.

It was founded by Sir Benjamin Thompson, or, as he preferred to call himself, Count Rumford in the Holy Roman Empire, and was an offshoot or extension of a Society for Bettering the Condition and Increasing the Comforts of the Poor, formed in 1796, according to the proposals of that somewhat eccentric genius. His ideas on the matter were formally submitted to a select committee of that Society, which reported in their favor on February 1, 1799. The next step was to circulate a definite outline of the scheme among people who were thought likely to subscribe to the undertaking, and so successful was their appeal to the public that 58 of the 'most respectable names' were obtained in a few weeks. On March 7th these original subscribers of 50 guineas each met at the house of Sir Joseph Banks, then President of the Royal Society, and elected a committee of managers, who were desired to take preparatory measures for opening the Institution, and in particular to solicit the King for the grant of a royal charter, which was obtained early the next year. Less than two months later the purchase was ordered of Mr. Mellish's house in Albemarle Street, and on June 5th the managers held their first meeting on the premises, which have ever since remained the home of the Royal Institution.

This, as may easily be inferred from the circumstances of its origin, was in the conception of Rumford a very different style of place from what it subsequently became. It was, in fact, nothing but a glorified mechanics' institute, its objects being, as defined in his proposals, the speedy and general diffusion of the knowledge of all new and useful improvements, and teaching the application of scientific discoveries to the improvement of arts and manufactures and to the increase of domestic comfort and convenience. The first was to be attained by the public exhibition, preferably in actual operation, of useful inventions applicable to the common purposes of life. A perusal of the detailed measures by which this end was to be achieved almost makes the reader suspect that in the Count's view salvation was to come by cooking. His list of the things to be shown in the repositories, indeed, includes models of 'that most curious and most useful machine, the steam engine,' of ventilators, lime-kilns, spinning wheels and looms, agricultural implements, bridges of various construction, etc., but the place of honor is given to stoves of all sorts and to the 'most perfect models of the full size' of kitchens and utensils suitable for a cottage, a farmhouse and the family of a gentleman of fortune, respectively. The Institution, too, had not been in existence for a year when a good cook was engaged for the "improvement of culinary advancement, one object and not the least important for the Royal Institution," while another of Rumford's

pet projects was the establishment of a dining-room in the house where experimental dinners could be ordered, to test the merit of any new method of cooking or any new dish that may be proposed. To attain the second of the primary objects of the Institution, Rumford proposed to fit up a lecture room for philosophical lectures and experiments and to provide a complete laboratory and philosophical apparatus for making chemical and other experiments. Only men of the first eminence in science were to be invited to "officiate in the most important and distinguished situation of lecturers," and, to judge from the prospectus, they were to confine themselves to the most severely practical applications of science.

For the first two or three years Rumford devoted all his energy to the realization of his ideas, and it is evident enough that during that time he was the ruling spirit of the Institution. The first part of his scheme to be brought into operation was the course of philosophical lectures. These were begun in March, 1800, Dr. Garnett being the first professor. For a time a temporary lecture-room was used, but it was not long before the theatre, built from the designs of Webster, was brought into occupation. This room, which is singularly successful in its acoustic properties, remains substantially unaltered at the present day, the chief structural changes being the abolition of a stone staircase that led directly from the upper gallery to the street, and the improved exit, which was finished only a month or two ago. The only other important event in the first year of the Institution's existence was the appointment of 14 committees for the purpose of specific scientific investigations; but that the managers had not the least idea of promoting what we should now call original research in pure science is obvious from the subjects into which they were to inquire. Rumford's hand is plainly discernible in the list, which includes bread, soup, cottages, stoves, household furniture, food for cattle, mortar and cement, fireballs and combustible cakes, etc. In the next two years still greater progress was made. The chemical laboratory was brought into use, and a director, operator and assistant were appointed; the workshops, in which models of new and useful inventions were to be constructed and sold at reasonable prices to subscribers and professors, were finished and provided with the best tools obtainable; a number of skilled mechanics were engaged, and arrangements were made for the reception of ingenious and well-behaved young men, who were to be boarded in the house, working in the workshops by day and in the evening attending classes in drawing, practical geometry and mathematics, under the direction of the clerk of the works (Mr. Webster).

But in 1802 a change began to make itself felt. Doubtless the circumstances that personal reasons caused Rumford to leave England and relinquish the superintendence of the Institution was not without influence, but the main factor was want of money. Rumford was perhaps justified in writing early in 1801 that the Institution was 'not only the fashion, but the rage'; but in 1802 the case was certainly different. In 1799 the income was £6,379 and in 1800 £11,047, but in 1801 it fell to £3,474 and in 1802 to £2,999, while at the same time the expenses were increasing. In short, the state of affairs became so bad that the idea was seriously discussed of closing the place and selling off its property to pay its debts. Luckily, however, it was saved, and the management passed into the hands of men stigmatized by Sir Joseph Banks as 'the enemy' and 'the profane,' which was, perhaps, his way of saying that they possessed some businesslike instincts. Quietly dropping the kitchens, the models, the workshops and the school for mechanics, in

which Rumford's interest had centered, they determined to carry on the scientific establishment and to get money for so doing by giving 'fashion to science.' This policy may not have been magnificent, but it was successful, and has resulted in securing to the Royal Institution a place in the history of scientific progress which all the patent stoves and roasters in the world would never have assured. Nor, after all, was there anything very dreadful about it. The private patron of science or art is not despised because his liberality has afforded some struggling genius the opportunity of using his talents; why, then, should an institution have been abused because it set itself to organize the public into a sort of collective patron?

The domestic record of the Royal Institution from the time when, in Davy's words, it definitely took the "form of a body for promoting experimental science and for diffusing every species of philosophical knowledge" contains few events of surpassing interest. Financial crises have been not infrequent, and sometimes acute, but have never proved fatal. Increased prosperity was hoped for as a result of the modification of its constitution by Act of Parliament in 1810, but its first endowment, some 23 years later, was none the less welcome. This consisted of a sum of £10,000 from John Fuller, and rumor says that it was a token of gratitude because the lecture theatre of the Institution was the only place where he could overcome the insomnia from which he habitually suffered. With two-thirds of the money professorships of chemistry and physiology were to be endowed, while the remaining portion went to form an accumulating fund, the interest on which, when the capital amounted to £10,000, was to be applied to the general purposes of the Institution. Since then it has received many legacies and donations. Money left by Mr. Alfred Davis in 1870 enabled the chemical laboratory to be rebuilt in accordance with modern requirements; in 1892 Mr. T. G. Hodgkins, of Setauket, Long Island, gave $100,000 for the 'investigation of the relations and corelations existing between man and his Creator'; and in 1896 Dr. Ludwig Mond founded and endowed the Davy-Faraday Research Laboratory, which is contiguous to the Royal Institution and under the superintendence of its managers. This is specially interesting as being in great measure the realization of a scheme which the Institution all but adopted more than half a century before. In 1843 a proposal was made to establish on its premises a school of chemistry, not only to give instruction to students, but to provide a place where original research could be carried on by skilled workers. The scheme met with cordial approval from Faraday and the managers of the Institution, and they only abandoned it because they were reluctantly driven to the conclusion that the accommodation was not sufficient to carry it out properly. Since that time schools of chemistry have been started in abundance, but no place designed exclusively for the prosecution of independent research existed in England until Dr. Mond's liberality provided this laboratory, which is open to qualified workers without distinction of sex or nationality.

The real history of the Royal Institution is the history of the discoveries made by the distinguished men who have worked in its laboratories, and to write that in full, at least for the early part of this century, would be little less than writing the history of scientific progress in England. The Institution had the good fortune to secure among its first professors three of the greatest natural philosophers this century has known. The first, Thomas Young, was a man of the most remarkable and varied attainments, but, perhaps, his best title to fame is that he was one of the prime found-

ers of the wave theory of light, which plays so important a part in modern physics. It was left to later generations to appreciate his merits in this respect and to discover that he had anticipated many points for which Fresnel was given the credit. Sir Humphry Davy's tenure of the professorship was nearly coextensive with his scientific life. Engaged in 1801, he immediately proved himself not only a lecturer of singular charm, but a most skilful and prolific investigator. His most far-reaching researches were probably those on the chemical agencies of electricity, for it was in the course of them that he decomposed the alkalies by a strong electrical current, thus not only discovering the metals sodium and potassium, but laying the foundations of electrolytical chemistry, a science whose industrial applications are now becoming more numerous and important every day. In addition, he made many researches in pure chemistry, and his work in the philosophy of flame led to the famous invention of the miner's safety lamp. The third of this triumvirate, Michael Faraday, entered the service of the Institution as assistant in the laboratory and rose to be its chief ornament and support. His scientific output during the 50 years in which he labored is quite unequalled for range and quality, including, as it does, researches in alloys, new organic compounds, optical glass, the liquefaction of gases, regelation, the action of metals on light, magnetism and diamagnetism, the magnetization of light, and the induction of electrical currents. The place of honor must undoubtedly be assigned to his work in the last department, not only because of its enormous theoretical significance, but also on account of the practical results of which it has been the starting point; it forms the foundation of the huge and increasing fabric of modern electrical engineering.

Another distinguished name in the annals of the Royal Institution is that of John Tyndall, who for 34 years maintained the traditions of the place as a brilliant lecturer and experimentalist. His researches were numerous and varied, the main ones relating to heat, to sound and to the behavior of small particles, such as compose dust, whether of living or dead matter. Of the first the difficult investigation of the absorption by gaseous bodies of invisible radiation is the most important, but his book on 'Heat considered as a Mode of Motion' is a classic which shows to advantage his splendid power of popular scientific exposition. In sound some of his most interesting work, that on the laws governing the audibility of foghorns and other signals in thick weather, was done as scientific adviser to the Trinity Board, a position in which he succeeded his friend and colleague Faraday, while his inquiries on atmospheric dust yielded results of great value alike to the physicist and the biologist. Tyndall was succeeded, both at the Royal Institution and the Trinity House, by Lord Rayleigh, who is universally recognized as one of the ablest mathematical physicists now living. Doubtless he is best known popularly in connection with the discovery of argon, but, in fact, his scientific reputation rests upon investigations of the most abstruse and difficult kind and upon practical achievements, among which the isolation of a new gas takes a secondary place. Of the men who followed Faraday in the chair of chemistry all are still at work. The first, Sir Edward Franklin, perhaps, in strictness should not be called a successor of Faraday, since he never held the Fullerian professorship, which was bestowed on Faraday for life, but he was appointed professor of chemistry when the latter's failing health obliged him to give up lecturing, and in the laboratory of the Royal Institution he carried out some of those researches on organo-metallic compounds which stamped him as one of the

most remarkable experimentalists of the time. The next two Fullerian professors were Dr. Odling and Dr. Gladstone, and the fourth was Professor Dewar, the present occupier of the chair, who was appointed in 1877. Continuing the work initiated by Faraday on the liquefaction of gases, he has succeeded in proving by experiment that, as indicated by theory, there is no such thing as a 'permanent gas;' for, since his recent liquefaction of fluorine, helium and hydrogen, no known gas remains that has not been reduced to the liquid state. His work has opened up an entirely fresh field of physical research, and, rich as the first results have been so far, they are in all probability only small in comparison with those which will be obtained by further investigation of the properties of matter near the zero of absolute temperature.

The Institution has undoubtedly been fortunate in the professors who have worked in its laboratories. But even genius cannot do much without opportunity, and, therefore, some of the credit is deserved by the long succession of officers and members of the Committee of Managers, who have for a hundred years looked after its business affairs and guided it safely through many vicissitudes, not only without fee or emolument, but at the expense of much time and not infrequently of much money. In this connection it is interesting to note that the presidency almost seems to have become an hereditary appanage of the Dukes of Northumberland, for, with the exception of the years between 1865 and 1873, when it was held by Sir Henry Holland, it has been in their hands continuously since 1842. Mention, too, must be made of what the members themselves have done. Over and above their regular subscriptions, they, with their friends, have contributed since 1863 something like £13,000 to the fund for the promotion of experimental research, and it is safe to say that had it not been for this fund English science in general would have been the poorer, and the Royal institution in particular would not possess the international reputation it bears to-day—a reputation won, be it remembered, in the good old English way, without state subvention or government aid. Modern scientific research daily becomes more costly, because apparatus grows in delicacy and complication, on the one hand, and in size and weight, on the other, and thus there arises a proportionate increase in the need for individual generosity. The fact that such pecuniary aid has been forthcoming in the last century warrants the expectation that the stream of benefactors to the Royal Institution will not fail in the next, and that they will enable it to point to as proud a record on its second centenary as it now does on its first.

SCIENTIFIC BOOKS.

The Elements of Practical Astronomy. By W. W. Campbell. New York, The Macmillan Company. 1899. Second Edition, Revised and Enlarged. Pp. xii + 264. Price, $2.

This second edition of a work favorably known to American astronomers who are charged with the duty of instruction appears in bulkier form and better mechanical execution than its predecessor, but with its general character not very greatly altered. Its merits and defects are to be estimated from the standpoint assumed by the author, who assures us that "My experience in presenting the elements of practical astronomy to rather large classes of students in the University of Michigan led me to the conclusion that the extensive treatises on the subject could not be used satisfactorily, except in special cases." In this opinion we heartily concur and, absolving the author from obligation to deal with the more specialized and recondite parts of his subject, we find his self-imposed task properly expressed in the words "It is intended that this book shall contain the elements of practical astronomy with numerous applications to the problems first requiring solution." For this